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New Soviet Crop Strategy: Problems and Prospects

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A Research Paper

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GI 86-10049
July 1986

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New Soviet Crop Strategy: Problems and Prospects [redacted]

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A Research Paper

This paper was prepared by [redacted] Office of Global Issues. Comments and queries are welcome and may be directed to the Chief, Strategic Resources Division, OGI, [redacted]

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New Soviet Crop Strategy: Problems and Prospects

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Summary

Information available as of 15 May 1986 was used in this report.

The Soviet Union is pursuing a new strategy that could have a major impact on Soviet agriculture in the next decade. By expanding the cultivation of high-yielding livestock feed crops, the Soviets hope to increase both the quality and quantity of domestically produced feed. This would improve meat production and, at the same time, control the need for grain imports. If Moscow succeeds in overcoming a number of significant, but not insurmountable, obstacles along the way, the United States could see its prospects for continued large grain exports to the Soviet Union shrink by the mid-1990s. 25X1

The new strategy—recently endorsed by Gorbachev—is, in our judgment, an attempt to exploit the Soviet Union's agricultural resources by shifting land out of low-yielding wheat into corn and sorghum grains, and soybeans—three high-value concentrated feed crops. According to Soviet plans, by 1990 the combined output of corn and sorghum grains should more than double from the 1976-80 average—a much larger gain than planned for overall grain output—and the output of soybeans, an important source of protein for livestock, should quadruple. 25X1

We believe that actual Soviet performance will show significant gains but fall short of the 1990 plan targets. Production of corn and sorghum grains will probably reach about 20 million tons—roughly double the 1976-80 average—although sorghum will remain a minor grain crop. Soybean output, as well, will double to 1 million tons but will reach only about half of the plan target. Although there will be a small loss of wheat, the net gain in grain production will still be 5 million tons by 1990. 25X1

These gains, while important, are only a small part of the longer term potential of this program. Our analysis suggests that moisture and temperature conditions on 60 million hectares of cultivated land in the southern USSR make cultivation of corn and sorghum feasible where wheat and other lower yielding small grains are now grown. If Moscow decided on fuller exploitation of a change in the crop mix in these regions, our analysis shows that annual Soviet grain output could increase by up to 30 million tons by the year 2000, as compared with the present crop mix.

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To achieve these gains, the Soviets must overcome a number of technological and institutional obstacles:
- Appropriate seed supplies will be limited because the Soviet Union seriously lags in breeding suitable corn, sorghum, and soybean varieties tailored to its unique agroclimatic conditions, and major improvements will take upward of 10 years.
- Agrochemicals to increase yields and control weeds and pests are in short supply.
- The development and manufacture of machinery specifically designed to cultivate and harvest row crops effectively is lagging behind farm needs.
- Economic incentives are still not strong enough to overcome local farm officials' preferences for producing traditional crops with lower yields.

Moscow will need to devise more effective policies to spur the domestic agrotechnology industry and to encourage greater willingness at the farm level to shift production into the new crops. 25X1

The great potential of this program and the early gains Moscow seems positioned to achieve have a number of significant implications for the United States:

- The program poses a serious threat to US interests in continued large US grain exports to the Soviet Union. With the USSR traditionally short of domestically produced concentrated feeds and protein supplements and the United States traditionally the world's leading exporter in these areas, the United States has been in a strong position to capture a big share of the Soviet import market. If Moscow succeeds in dramatically raising domestic production of these feed grains, US exports will suffer and any US influence derived from this trade linkage would be seriously diluted.

- The program has the potential for important gains in agrotechnology trade. Moscow recognizes that the ultimate success of changes in the crop mix during the next 10 to 15 years will depend heavily on aggressive application of improved agrotechnology and is already looking to the West for help. Efforts have been under way for some time to acquire better seeds from Western firms, and an initial agreement on corn seed and technology was signed in 1985. The most sophisticated agrochemicals are already obtained from the West and crop volumes are likely to grow

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substantially. Moreover, Moscow has looked to the West to obtain advanced machinery to improve cultivation and reduce harvest losses in the new crops.

Because of the potential impacts the crop mix program can have on US trade prospects with the Soviet Union—large possible losses in grain exports partially offset by smaller gains in technology exports—the success Moscow has in this program and the priority given it will be major harbingers of US-Soviet trade prospects in the 1990s. 25X1

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Contents

Sanitized Copy Approved for Release 2011/03/30 : CIA-RDP97R00694R000600260001-6

Sanitized Copy Approved for Release 2011/03/30 : CIA-RDP97R00694R000600260001-6

Sanitized Copy Approved for Release 2011/03/30 : CIA-RDP97R00694R000600260001-6

Sanitized Copy Approved for Release 2011/03/30 : CIA-RDP97R00694R000600260001-6

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Figures

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USSR's Feed Crops in Perspective

The most important concentrated feeds in the USSR are small cereal grains such as wheat, barley, oats, and rye—instead of corn, sorghum, and soybeans, which are the mainstays of the US livestock program. Concentrated feeds increased as a share of all feed energy in the USSR from 22 percent in 1960 to 36 percent in 1979. Since then, forage (hay, silage, straw, and pasture) output—still the principal source of feed energy for Soviet livestock—has increased somewhat faster than the use of grain for feed. Corn—the primary grain for providing energy in US livestock feed—has made a significant contribution in the Soviet Union to the overall feed supply, not as a grain, but as a forage crop.

The Soviets want to further increase output and improve the quality of forages because they are a necessary ingredient in livestock feed management. Better forages are essential for maximizing returns in the use of cereal grains and in feeding certain livestock such as cattle and sheep. When properly managed, forages also offset vitamin and protein deficiencies found in some cereals. US farmers typically use forage and pasture as the principal feed for young cattle prior to fattening in livestock feed lots with concentrated feeds.

As in the United States, both cultivated and uncultivated lands contribute to Soviet feed supplies for raising livestock. Three-fourths of the crop production grown on the 227 million hectares of cultivated land and all of the output from the 373 million hectares of natural meadows and pastures are used for livestock feed in the USSR:

- *Grain crops currently occupy about 60 percent of the cultivated lands (including fallow), and over half of all the grains produced from this area is directly allocated to feed. The remainder of the grain, except that used for seed, provides grain for the food products industry—flour milling, starch extraction, and brewing and distilling alcohol, for example. The residuals from this processing—or the byproducts, such as bran—are also fed to livestock. In addition, straw and chaff from the grainfields provide forage for feed.* 25X1

- *Almost a third of the cultivated land is devoted exclusively to forages—alfalfa, clover, corn for forage, and the like.*

- *The remainder of the cultivated lands—some 10 percent—also provides some feed in the form of surplus and waste products, and the nonfood byproducts of potatoes, vegetables, sugar beets, and oilseeds.*

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Finally, the uncultivated lands—the 373 million hectares of natural meadows and pastures—provide hay, green feed, and grazing. In total, over 90 percent of Soviet farmlands—cultivated and uncultivated—contribute some form of livestock feed. 25X1

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New Soviet Crop Strategy: Problems and Prospects [redacted]

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Soviet Strategy and Prospects

The USSR Food Program [1] for the 1980s, formally adopted by Moscow in May 1982, focuses on agricultural organization, management, and investment issues. The goal is to improve the Soviet diet by providing consumers with larger supplies of meat, milk, eggs, and other scarce foods, and to reduce the imports of grains and other feeds needed to produce livestock products. [redacted]

Soviet strategy to improve both the quantity and quality of domestically produced livestock feed depends in part on substantial boosts in output of corn, sorghum, and soybeans—an objective stressed by Gorbachev during 1985. The strategy is keyed to replacing lower yielding traditional crops with higher yielding feed crops like corn and sorghum (see figure 1). In general, the strategy calls for a sharply lower share of wheat—from 49 to 28 percent of grain output. According to official Soviet plans, corn grain production should more than double by 1990 and output of soybeans is to more than quadruple, compared with the 1976-80 average annual level. Sorghum grain production should increase substantially. By comparison, all feeds (see inset, USSR's Feed Crops in Perspective) are to increase only by about a third. [redacted]

Our analysis suggests that the Soviets will make important strides in their efforts to restructure the crop mix but plans are not likely to be met (see table 1). By 1990 the production of corn and sorghum will be about twice the 1976-80 levels, and this shift in

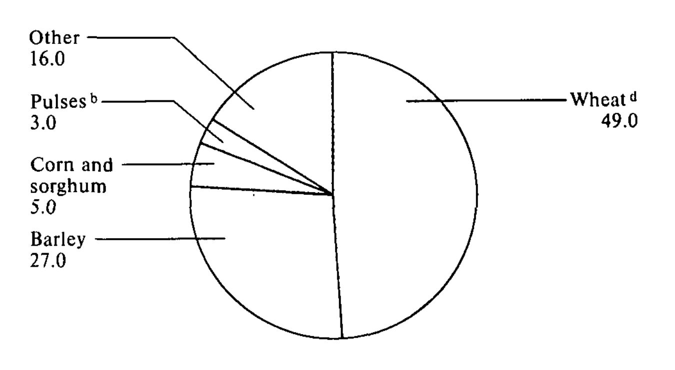
[1] The Soviet Communist Party considers food the central economic and political problem of the decade. USSR food consumption overall is adequate in calories but deficient in livestock products, fruits, and vegetables compared with Western diets. [redacted]

[redacted]

Figure 1
USSR: Current Grain Mix Compared With 1990 Preferred Levels

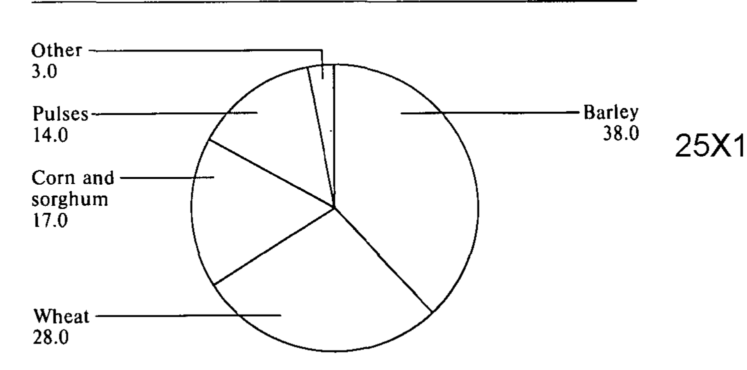
Percent of total grain output

Current level[a]



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Preferred level[c]



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[a] Based on average annual statistics on grain output during 1976-80.
[b] While pulses (edible legume seeds such as beans, peas, and lentils) are not grains, the Soviets include them along with seeds from grass crops in grain output statistics. Soviet estimated requirements for pulses apparently include soybeans, usually grouped with oil seeds.
[c] *Voprosy Ekonomiki,* No. 5, April 1983, pp. 79-87. Translated in JPRS, L/11513, USSR Agriculture (FOUO), 14/83, 9 August 1983, pp. 6-16.
[d] The Soviets prefer to reduce spring wheat grown in the northern areas—replacing it largely with barley since it outproduces spring wheat.

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Table 1
USSR: 1990 Production Goals and Outlook for Corn, Sorghum, and Soybeans

Million tons

	Historical Production Average Annual		Goals and Projections	
	1978-80 [a]	1984-85 [b]	Soviet Plan [a]	Production [b]
Corn grain	9.5	13.7 [c]	22.0	20.0
Sorghum grain	0.1	0.2	NA [d]	0.3
Subtotal	**9.6**	**13.9**	**22.0**	**20.3**
Soybeans [e]	0.5	0.5	2.2-2.3	1.0

[a] [redacted] USSR crop data in this report are from the press and are unclassified. Soviet statistical yearbooks have given no data for all-USSR production of corn or other grain since 1980 and for jurisdictions below republic level since 1970, [redacted] In January 1985, a Soviet official explained that comprehensive data would not be published until the USSR became self-sufficient in grain output.
[b] CIA estimates.
[c] In late November 1984, the former Soviet Minister of Agriculture generalized that corn grain output in the last few years "reached a stable level of 13-14 million tons."
[d] The Soviets have not published 1990 production goals for sorghum grain. We assume, however, the planned rate of increase is the same as that for corn.
[e] Soybeans are not grains, but oilseeds high in protein content.

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crop mix—with a small loss in wheat—will probably add about 5 million tons to total grain supplies. Substantial increases should also be made in soybean production. We believe, however, that the potential for gains from further shifts toward corn, sorghum, and soybeans is much greater than the gains we expect the Soviets to achieve during the near term. In fact, analysis developed in this paper indicates that net gains of 20-30 million tons in grain output are feasible by 2000 through crop mix changes alone. [redacted]

Corn, Sorghum, and Soybeans: Key Advantages

Our analysis suggests that the Soviets—even by 1990—will realize several important advantages by restructuring their crop mix to produce more corn, sorghum, and soybeans. Moreover, these gains will be achieved economically. Because corn, sorghum, and soybeans have greater yield potential, substantial gains can be made by simply substituting these crops for the more widely grown traditional crops such as wheat:

- *Increased yield.* In regions best suited for their cultivation and with proper tillage, corn and sorghum significantly outproduce other grains. Even in the southern part of the USSR, with less than ideal agroclimatic conditions for these feed crops, average corn yields, for example, are roughly 30 percent more than winter wheat (see inset, USSR's Agroclimatic Conditions). 25X1

- *Improved feed quality.* The nutritional value of corn, sorghum, and soybeans substantially outranks the crops they would replace:

  — Corn and sorghum are especially valuable for concentrated energy; soybeans are superior for protein content, although they yield less energy per hectare than either corn or sorghum.

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USSR's Agroclimatic Conditions

The USSR's agroclimatic conditions are relatively unfavorable for corn, sorghum, and soybeans. Only limited regions of the southern USSR—parts of Moldavia, the western Ukraine, the North Caucasus foothills, and a few places in the Transcaucasus—plus the Far East regions approach the favorable combination of temperature, moisture, and soils of the US corn belt. The main corn grain regions in Europe and North America generally have longer and warmer growing seasons because of their more southern locations and also enjoy more and better distributed precipitation than most corn grain regions in the USSR.

Under current Soviet practices, a short growing season is the prime climatic impediment to expanding output of these feed crops, though better varieties and tillage practices can significantly expand their range of adaptation. The best areas—or areas of longer growing seasons—are the southern regions, but many of these areas are most deficient in annual precipitation. About half of all the USSR's tilled land receives less than 305-356 millimeters (mm), and only a small share has more than 610 mm, compared with 762-1,016 mm for large portions of the US corn belt. Irrigation and moisture-conserving practices, therefore, will be the key to increased production of these feed crops in the southern USSR, which otherwise has considerable potential to grow them.

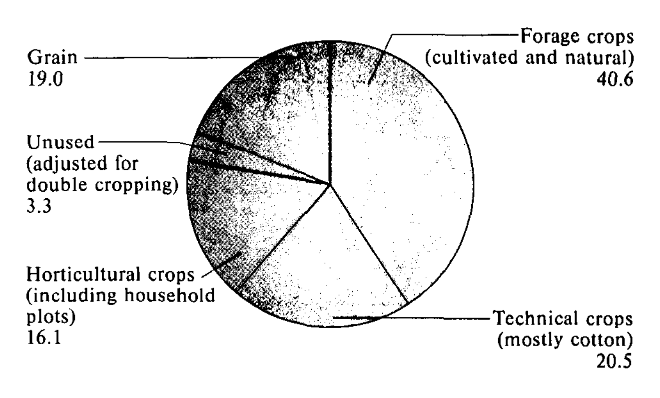
— Because of good mixing qualities, blends of corn or sorghum and soybeans make excellent livestock feed rations that are ideal for maximizing livestock productivity. In contrast to forage crops, concentrated feeds are suitable for all classes of livestock and are necessary for feeding poultry and swine, for intensive fattening of cattle and sheep, and for yielding maximum milk production. They are also more easily transported and stored than bulky forage crops.

- *Higher returns from irrigation.* Increased plantings of corn, sorghum, and soybeans would help the Soviets take better advantage of their investments in

Figure 2
USSR: 1980 Grain Production on Irrigated Land

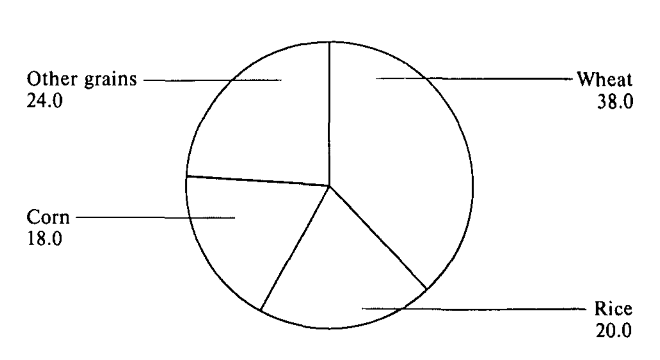
Percent

Share of Total Irrigated Land



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Share of Irrigated Grain Land by Crop Type



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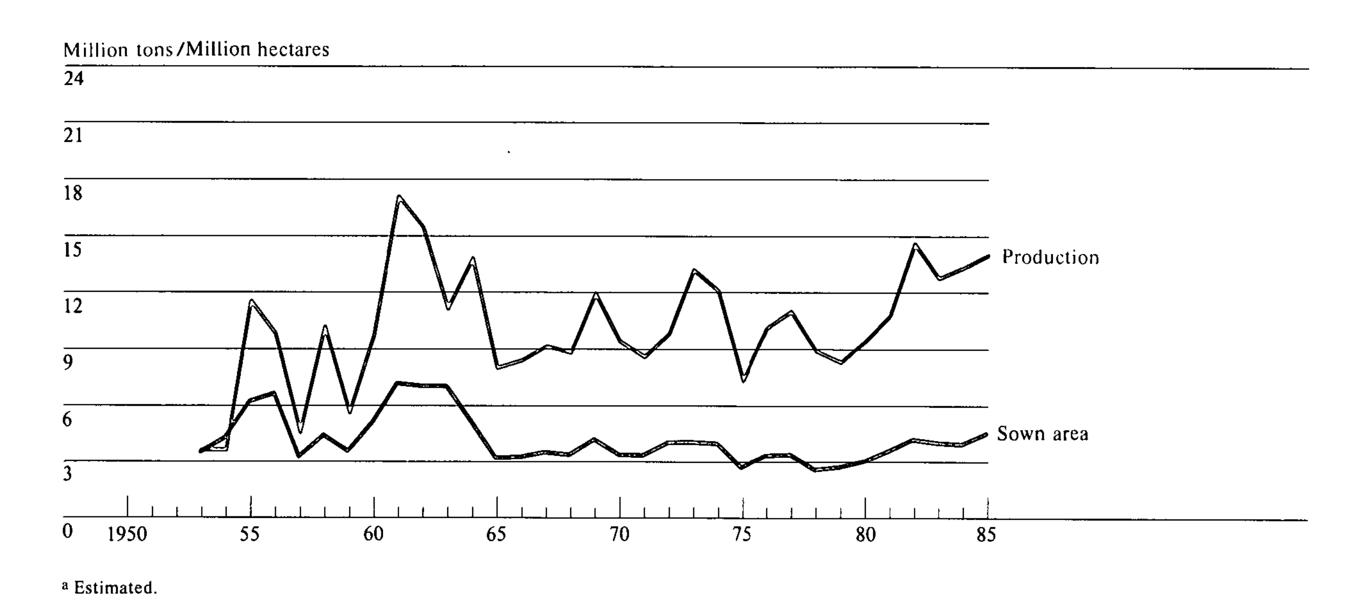
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Figure 3
USSR: Corn Grain Trends, 1950-85[a]



[a] Estimated.

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Table 2
USSR: Imports of Grain and Soybeans From All Sources, 1980-84

	Million Tons		Billion US $ [a]	
	1980-84 [b]	1984	1980-84 [b]	1984
Total	**38.0**	**45.0**	**6.0**	**6.8**
Corn	11.7	12.5	1.6	1.7
Sorghum	2.5	2.0	0.3	0.2
Soybeans and meal [c]	2.5	0.7	0.6	0.2
Other	21.3	30.2	3.5	4.7

Source: Official Soviet statistics.

[a] Values are converted from rubles to dollars using the official exchange rate for each year.
[b] Crop year averages.
[c] In soybean equivalent, assuming 78 percent yield of meal.

Table 3
USSR: Imports of Grain and Soybeans From the United States, 1980-84

	Million Tons		Billion US $	
	1980-84 [b]	1984	1980-84 [b]	1984
Total	**10.8**	**17.3**	**1.60**	**2.60**
Corn	6.3	9.4	0.70	1.30
Sorghum	0	0	0	0
Soybeans and meal	0.3	0.1	0.09	0.04
Other	4.2	7.8	0.81	1.26

Source: Official Soviet statistics.

[a] Values are converted from rubles to dollars using the official exchange rate for each year.
[b] Crop year averages.

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the Land Reclamation Program.[2] The program calls for major outlays for irrigation, especially in the southern portion of European USSR where climatic conditions for these three feed crops are relatively good. The Soviets intend to expand irrigation, principally in these areas, to 23-25 million hectares by 1990 and to 30-32 million hectares by 2000, compared with about 18 million at the present. Furthermore, even for the near term, we believe that the Soviets could allocate proportionally more of their existing irrigated land to these three crops than to the less productive traditional crops (see figure 2). In 1980 more than 60 percent of all irrigated grainlands was devoted to wheat and other lower yielding grains as compared with only 18 percent for corn. [redacted]

In general, these three crops would boost productivity of cropland if planted on a larger share of the roughly 60 million hectares of cultivated land in the southern USSR, where small grains predominate—including Central Asia with almost 8 million hectares of irrigated land and a 260-day frost-free growing season. Throughout the southern USSR, only 40 to 60 percent of the growing season is used with the current crop mix. Since most small grains are harvested by midsummer, they do not use the full growing season as do corn, sorghum, and soybeans. Furthermore, in Central Asia it would be possible to increase the amount of irrigated land that is double-cropped—two crops grown per year—with increased plantings of corn, sorghum, and soybeans. Because irrigated crops suffer less from the vagaries of weather, this would permit Moscow to reduce somewhat the large annual swings in grain production that tend to characterize Soviet agriculture. [redacted]

[2] In Soviet terminology, reclamation is the improvement of lands, primarily through drainage or irrigation. [redacted] The Soviets attribute three-fourths of the increase in crop output during 1976-80 to reclaimed lands. They refer to land reclamation as "a decisive factor for the further increase in agriculture and steady growth in the country's food resources." In a special 23 October 1984 Central Committee plenum of the Soviet Communist Party, the Soviets reaffirmed their support for costly, continuing land reclamation projects and extended investment and production plans to 2000. Chernenko specifically urged planting more corn to improve returns from irrigated land. [redacted]

Recent Trends in Production and Imports

While domestically produced livestock feeds supply the bulk of Soviet requirements, Moscow must still import grain as a major source of livestock feed because of frequent shortfalls in grain production goals (see tables 2 and 3). Soviet imports of corn and sorghum grain during the crop years from 1980 to 1984 averaged 37 percent of all grain imports and 58 percent of grain imported from the United States. In recent years poor sunflower and pulse crops forced the Soviets to import soybeans and soybean products amounting to several times the level of domestic production to cover protein shortages (see appendix A). [redacted]

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Corn Production

Corn received a major push during the Khrushchev era, and some impressive gains were made. After Khrushchev's program was discredited, however, the area sown to corn grain has remained roughly 60 percent of the record 1960 levels (see figure 3). Of the 21.8 million hectares of corn area in 1984—principally in southern USSR (see figure 4)—only about 3.9 million hectares were harvested for 13.3 million tons of grain, according to official Soviet statistics and our estimates. The rest of the area planted to corn was used for forage. The corn grain figure is considerably short of the record year of 1961, when 17.1 million tons of corn grain were produced from 7 million hectares. [redacted]

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Whereas output has fallen well below the record level of 25 years ago, yields in 1984-85 were about 45 percent higher, reflecting in large part a higher percentage of production on irrigated land. Our analysis shows that 40 percent of the corn grain produced in 1984-85 was from irrigated land compared with only 5 percent in 1966-70. Nonetheless, Soviet yields are still less than half the average US corn yield. [redacted]

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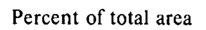
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Figure 4
Distribution of Corn Cultivation



Percent of total area

Kazakhstan 1.8
Central Asia 3.2
Transcaucasus 5.0
Moldavia 11.7
North Caucasus 17.1
Central Chernozem 1.7
Volga 0.1
Far East 0.2
Ukraine 59.2

Baltic
Northwest
Northern
Belorussia
Central
MOSCOW
Moldavia S.S.R.
Ukraine
Volga-Vyatka
Central Chernozem
Volga
Ural
North Caucasus
Trans-Caucasus
West Siberia
Soviet Union
East Siberia
Far East
Kazakhstan

Corn
Grain
Forage
Northern limit for growing grain
Economic region boundary
0 1000 Kilometers
0 1000 Miles

Moldavia SSR is not part of any economic region.

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A Soviet machine for separate but simultaneous harvesting of husked corn ears and chopped cornstalks. While the Soviets are generally in need of farm machinery, they have some unique harvesting equipment for corn, and most of the Soviet cornfields that are harvested for grain are also harvested for forage. Unlike the United States, where fields harvested of corn grain are later grazed by cattle, the Soviets prefer to bring forage to the farmsteads—reflecting a different approach to livestock rearing, a more critical need to utilize available forage, and a general lack of fences to facilitate grazing on the USSR's farmlands. [redacted]

On the basis of an analysis of geographical regions suitable for growing corn grain, we estimate that at least 10 million more hectares could be planted with corn. The potential is especially good on the irrigated lands in southern regions where a high proportion of corn is still harvested for forage and a large percentage of irrigated land is used for other lower yielding crops. [redacted] 25X1

Sorghum Production

According to official Soviet statistics, the best sorghum grain harvest—219,000 tons—was in 1974 (see figure 5). Yields over the past 15 years have remained relatively constant, averaging 12.3 centners per hectare—no more than half of US yields. The area planted to sorghum has fluctuated considerably, however, as sorghum has often been used as a backup when more traditional spring grains (barley and wheat) failed to get a good start during the early stages of the growing season. [redacted] 25X1

On the basis of an analysis of agroclimatic conditions, we estimate that 2-3 million additional hectares could readily be planted to grain sorghum. It would be an ideal grain crop for the large semiarid regions of Central Asia and Kazakhstan because of its resistance to drought (see figure 6). However, until better varieties—especially hybrids—are introduced that are adapted to regional agroclimatic conditions, present yields will remain much below potential. [redacted] 25X1

Soybean Production

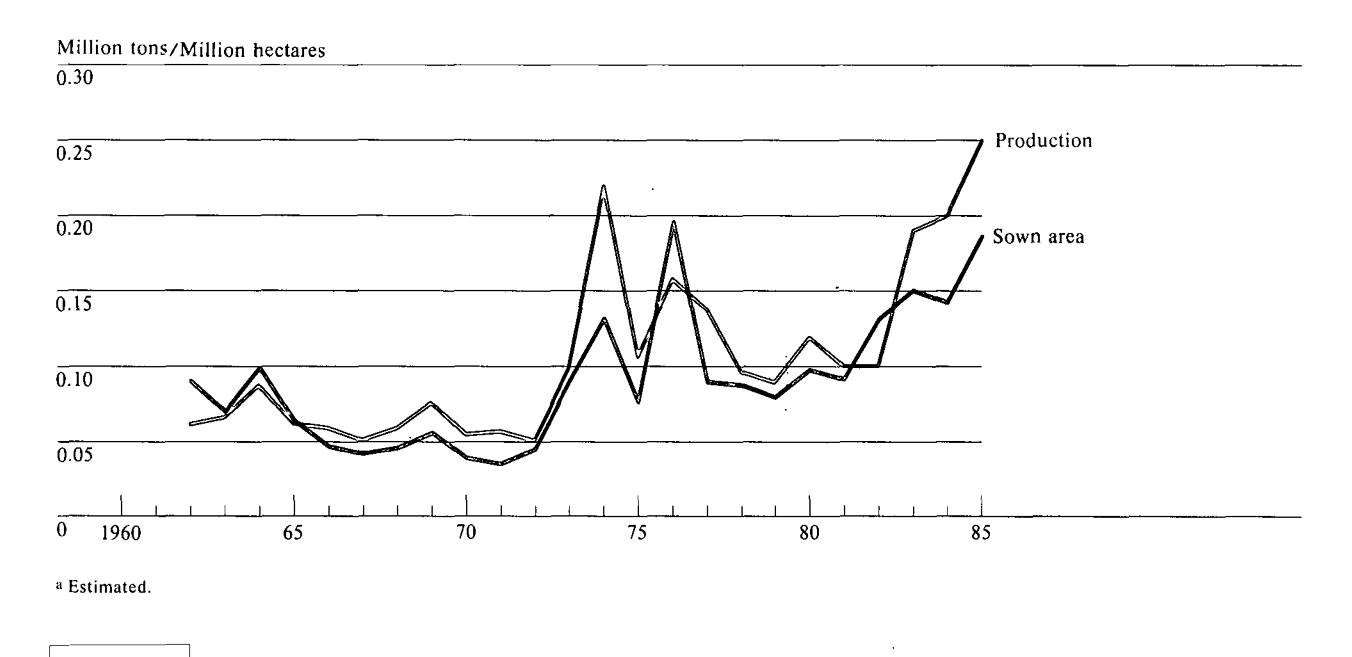
During 1981-83, soybean output averaged 497,000 tons per year, according to official Soviet statistics, about 35 percent less than the 1975 record level of 780,000 tons. Most of the reduction was due to unfavorable weather (see figure 7). The area sown to soybeans—mainly in the Soviet Far East (see figure 8)—has remained relatively constant during the past two decades. Soybean yields overall are very poor—less than one-third of US yields—largely because of 25X1 inferior varieties and a shortage of agrochemicals. In 1984 soybean output from irrigated and drained lands reportedly doubled, according to Soviet press reports, yet production overall was only 51 percent of plan.

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Figure 5
USSR: Sorghum Grain Trends, 1960-85[a]



[a] Estimated.

[redacted]

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Soviet plans call for soybean production to reach 2.2-2.3 million tons by 1990. Since the planted area is roughly to double, yields per hectare also must double if output by 1990 is to more than quadruple the 1976-80 level as planned by the Soviets. [redacted]

Technological and Institutional Constraints to Expanded Production

For the Soviets to make significant gains in production of corn, sorghum, and soybeans, they will have to overcome several major constraints. We judge the Soviets are at least 10 to 15 years behind the West in applying advanced agrotechnologies. Moreover, farming preferences are strongly oriented to traditional crops and cultivation practices. [redacted]

Agrotechnology Problems

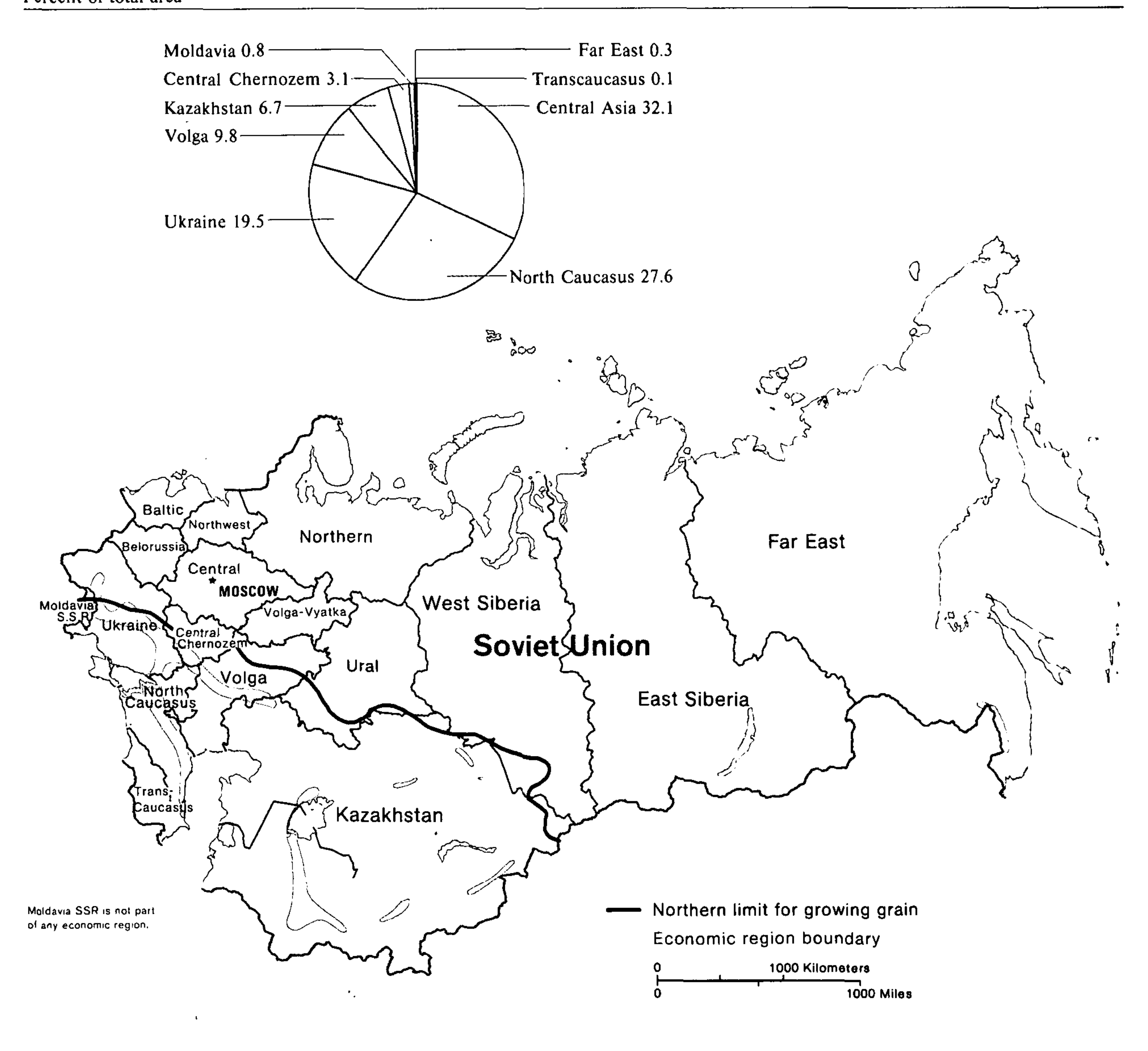
In our judgment, the lack of appropriate high-yielding hybrid seed of corn, sorghum, and soybean varieties is the most important technological restriction to increased Soviet production of these three feed crops. 25X1 Despite considerable capability in breeding small grains, especially wheat, the Soviets lag in developing and introducing varieties of these three feed crops tailored to agroclimatic zones that would make their production more reliable and more profitable. [redacted] 25X1 [redacted] the Soviets are at least 10 years behind the United States in corn-breeding research. 25X1 In our view, inadequate incentives have encouraged crop breeders to take shortcuts—especially in developing better corn varieties—rather than conduct fundamental research. Twelve or more years often are required to create, test, and introduce a new variety in any country, and the Soviet emphasis has been on wheat and not corn. 25X1 Moreover, a shortage of hybrid corn seed is a perennial problem. [redacted] 25X1

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Figure 6
Distribution of Sorghum Grain Cultivation[a]

Percent of total area



[a]Data were not available to precisely map the geographic distribution. The shaded area is estimated on the basis of 1956 hectarage data by oblast.

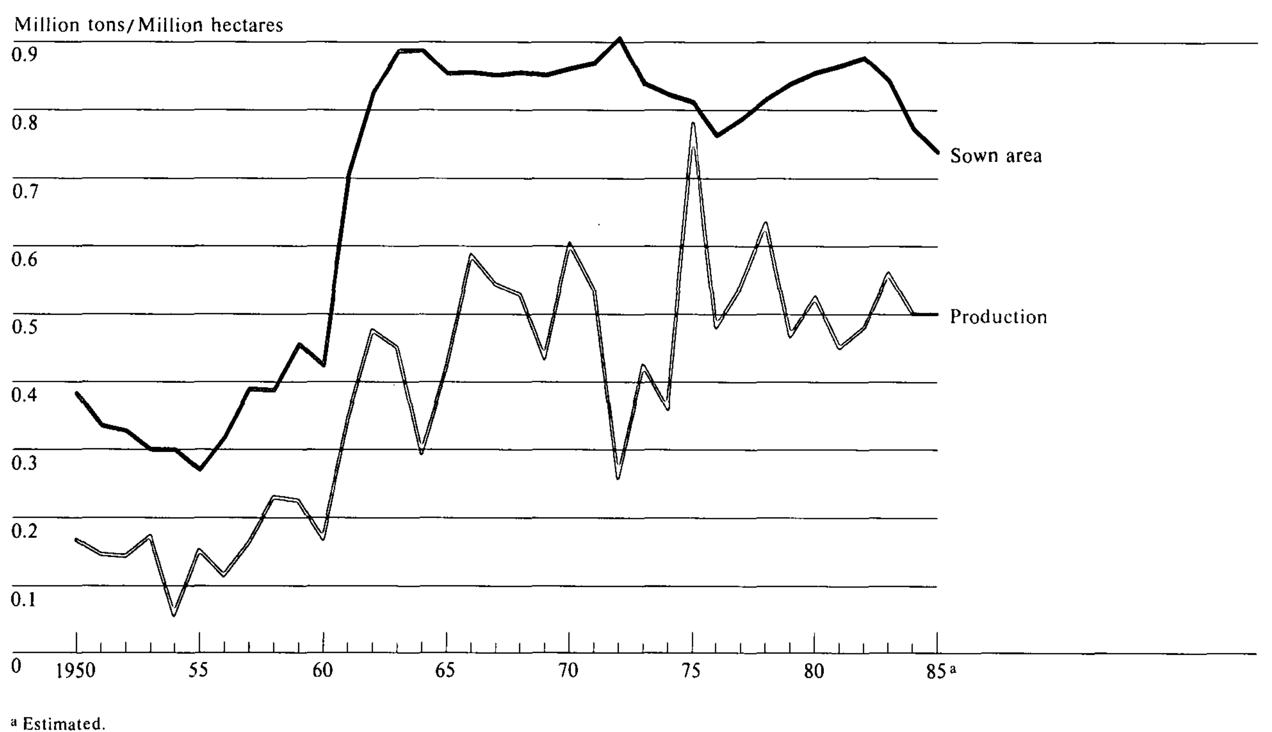
[redacted] 25X1

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Figure 7
USSR: Soybean Trends, 1950-85[a]



[a] Estimated.

[redacted] 25X1

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Another key technological problem is the lack of agrochemicals, as the Soviets admit in press reports. Fertilizers and herbicides are in great demand to increase yields and control weeds and pests. Corn grain planted on irrigated land receives 25 to 30 percent less fertilizer than the Soviets believe would be the optimum, according to press reports. Soviet research also indicates that soybean yields in the Soviet Far East—where most of the soybeans are grown—could be increased 50 to 100 percent by applying more herbicides, fertilizers, and lime to existing varieties. Excessive soil acidity, cited as the main reason for low yields in Amur Oblast, could be corrected by applying lime. Moreover, special agrochemicals tailored to soybean production are required to control weeds and pests, which reportedly reduce soybean yields on nonirrigated fields by 20 to 30 percent. The reduction is even greater on irrigated fields. [redacted] 25X1

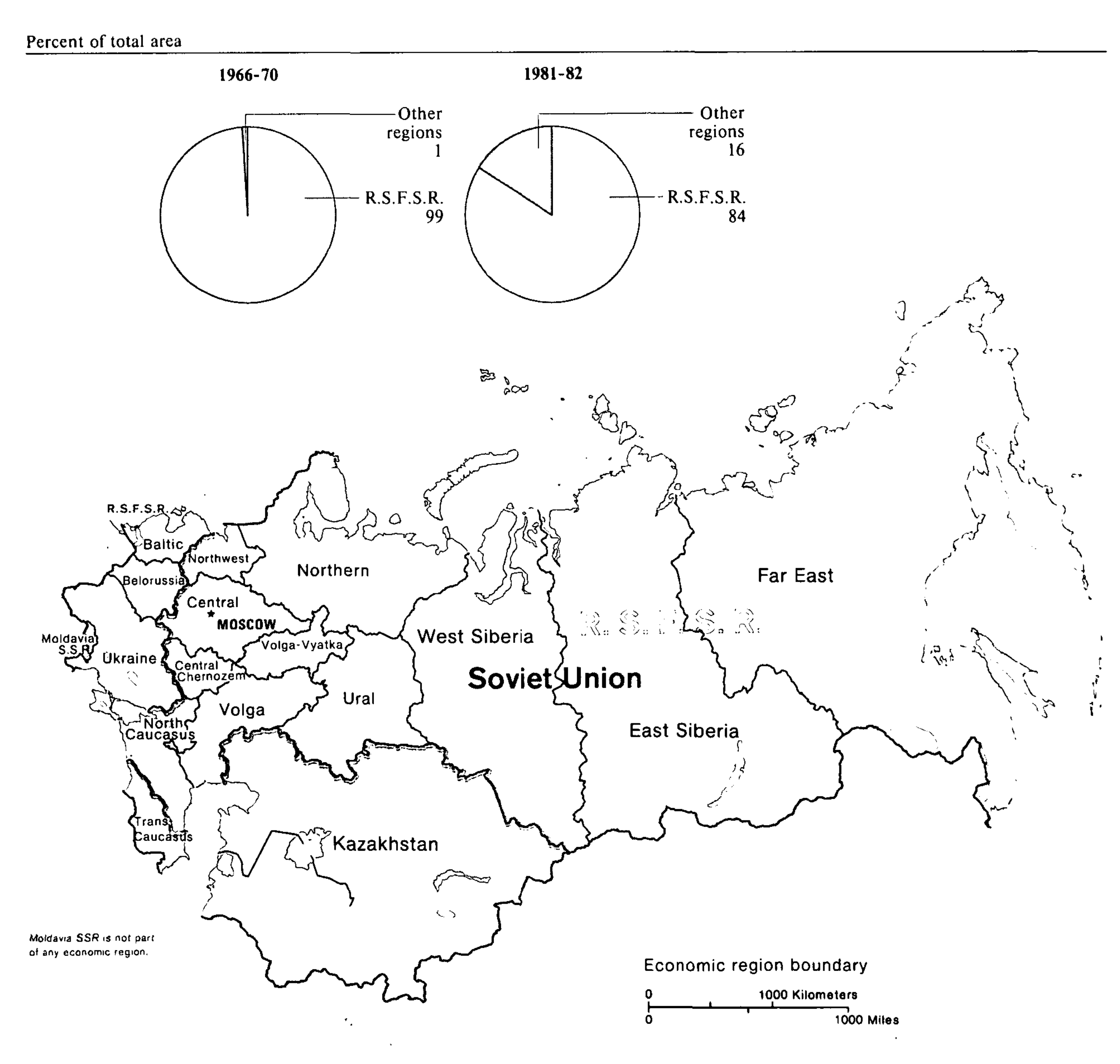
The Soviets also need more and better farm machinery to help cultivate these row crops and to reduce harvesting and handling losses. [redacted] 25X1 a lack of suitable equipment restricts application of tillage techniques needed to help conserve moisture and prevent soil erosion. 25X1 The Soviets need more up-to-date combines to reduce losses during harvest, [redacted] and, according to press reports, the Soviets are seriously 25X1

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Figure 8
Distribution of Soybean Cultivation

Percent of total area



[redacted]

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lacking in dryers to process these crops so that they can be stored for indefinite periods. Currently, much of the corn grain left on Soviet farms for feed is not dried, resulting in losses of 20 to 25 percent. Similar problems reportedly occur in handling sorghum grain and soybeans. [redacted]

Institutional Obstacles
We believe that increased production of corn, sorghum, and soybeans will also be limited by institutional problems. Although optimal soil and climatic conditions should determine the kinds of crops grown in various regions, the choice of crops in the USSR is heavily influenced by planner directives and, in turn, by the political leadership. Khrushchev's agrarian policies illustrated these influences. In addition, the desire by Moscow for national autarky in most types of production has led to the commercial production of some economically marginal crops. Sugar beets and cotton, for example, are grown in areas of the USSR better suited for the production of corn, sorghum, and soybeans and could be imported for less than the cost of producing them. [redacted]

At the local level, ineffective pricing policies are obstacles. Farm officials are resisting expansion of corn grain on grounds that the yield advantage over small grains does not offset the increased cost of producing row crops. Small grains post up to a 65 percent profit that, according to some Soviet farm officials, cannot be matched by row crops under the current pricing policy. The high priority placed on harvesting corn for forage also will probably continue to limit expansion of corn grain production unless incentives can be changed. The Soviet planners, moreover, insist that expansion of corn must not reduce the area of winter grains (primarily wheat)—in part because of their concern for the supply of high-quality flour for breadmaking—but instead must replace lower yielding spring grains. Given Soviet agrotechnology and agroclimatic conditions, however, it is difficult to grow corn and winter grains in a crop rotation. Our analysis shows that few regions have a long enough growing season—given current Soviet corn varieties—to permit corn grain to be harvested in time to plant winter grains. [redacted]

Resistance by farm officials is, in our view, also hindering the expansion of sorghum and soybeans. Farm officials in regions where these crops are being expanded are not, as a rule, familiar with correct growing practices, according to Soviet press reports. As a result, farmers in the Central Asian republics—where soybeans have considerable potential—reportedly show little enthusiasm for expanding soybean production. [redacted]

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Moscow is aware of these problems and has taken some steps to overcome them. On 1 January 1983 regional base procurement prices were increased slightly for wheat (5 to 12 percent) and substantially for barley, oats, and corn (18 to 39 percent). These price changes clearly work to encourage the desired shift in the crop mix, but it is still too early to know if they will have substantial impact at the farm level. [redacted]

25X1

In an effort to demonstrate to farm managers that yields can be increased and that costs of production can be reduced, the Soviet campaign to "industrialize agriculture" initially has been focused on corn and other row crops. Farms participating in the campaign are to receive preferential allocation of the best land, workers, machinery, and fertilizers and other agrochemicals—with the understanding that these resources will be utilized to obtain the highest returns. Part of the approach is to organize farm workers into "collective contract teams." Wages of team workers ostensibly are based on the level of output, the increase in labor productivity, and the reduction in cost of production they achieve on the lands that are assigned to them. On the basis of Soviet press reports, we judge, however, that off-farm officials currently interfere too much in team management, wages are still primarily based on job performance rather than on the size of harvest, and the necessary agrotechnology inputs—new hybrid varieties, fertilizers, and herbicides plus better machinery—are generally not available to improve overall yields and growing practices rapidly. [redacted]

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Efforts To Introduce Western Agrotechnology

In June 1985, General Secretary Gorbachev announced that one of the most serious problems in the Soviet economy, including the agro-industrial sectors, is the difficulty of putting science and technology into practice. While the Soviets have been monitoring global developments in corn, sorghum, and soybean technology and making selective purchases of seeds, agrochemicals, and machinery for some time, recent evidence suggests Moscow will look even more to Western agrotechnology for help with these and other crops in the future. [redacted]

Genetics and Seed Varieties

During the period 1974-77, the Soviets actively negotiated for corn, sorghum, and soybean germ plasm and other crop technologies from US, Canadian, and other Western commercial seed firms in an effort to acquire better seeds, [redacted] At that time, however, they were unwilling to enter long-term agreements that Western companies require in order to develop and produce higher yielding seeds specifically tailored to Soviet conditions. Instead, the Soviets purchased small quantities of US seed for testing and breeding stocks. More significant, in our view, in 1977 the USSR Ministry of Agriculture contracted with a US firm for joint Soviet-US experiments to demonstrate US-type soybean technology, including machinery and seed varieties, in the southern Ukraine (Crimea) and Krasnodar Kray, [redacted] The Soviets judged the project results as outstanding, and the findings provided additional rationale for expanding soybean production. [redacted]

Under pressure from General Secretary Gorbachev, the Soviets are now going to negotiate more aggressively for the purchase of US and other Western agricultural technology and consultative services, [redacted] They are interested in obtaining professional assistance in farm management and joint research ventures in genetics and biotechnology. The Soviets told then US Secretary of Agriculture Block, during his visit to the USSR in August 1985, that they wanted to buy foreign corn varieties.

[redacted] 25X1

25X1

In addition, from late 1984 through 1985 the Soviets were asking US firms to propose projects for improving their production and utilization of soybean seeds and other oilseeds, including feeding trials to demonstrate the use of high-moisture corn grain and soybean meal in livestock rations, [redacted] Soviet trade officials looked for soybean-processing technology, and hinted that funds intended for soybean imports might be diverted to buy Western feed-mixing equipment. Under the US-USSR Agreement on Cooperation in the Field of Agriculture, Soviet scientists have received seed of US soybean varieties. [redacted]

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Agrochemicals

The Soviets regularly import more than half of their agrochemicals from Western multinational firms and Eastern Europe. Many of these multinational firms are US based, and up to half of the agrochemicals that their West European subsidiaries sell to the Soviets is actually delivered from the United States. Since 1984 the Soviets have made special efforts to increase purchases of the most sophisticated forms of Western herbicides, insecticides, and fungicides, [redacted]

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[redacted] Agrochemicals are essential for corn and other row crops in order to apply modern cultivation practices—stubble mulch tillage rather than plowing. This practice helps prevent erosion, conserves moisture, reduces costs, and allows growing more than one crop per year. [redacted] 25X1

Machinery

[redacted] 25X1

The Soviets have also purchased better cultivation equipment. In 1984, [redacted] they bought a US line of machinery for ridge-row tillage—an adaptation of conservation cultivation for poorly drained lands such as those used for soybeans in the Far East. According to Soviet press reports, they lack equipment capable of properly cultivating the soil and simultaneously placing seeds, fertilizer, and other chemicals in the soil. [redacted]

Outlook

We judge that the Soviets will make significant production gains by 1990—although still not up to plan—mainly as a result of slightly larger plantings of corn, sorghum, and soybeans in those areas agroclimatically suitable for growing these crops. In the longer term, restructuring the crop mix will represent the most cost-effective option open to the Soviets to limit grain imports through greater domestic production. [redacted] 25X1

Figure 9
USSR: 1990 Planned and Estimated Production

1976-80 average annual production = 100

Planned
Estimated

0 100 200 300 400 500
Corn grain
Sorghum grain
Soybeans

[redacted] 25X1

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Significant Short-Term Gains Likely

Assuming trend-level weather, we estimate that *corn* grain production will reach 20 million tons by 1990, short of the planned goal by 2 million tons, but more than double the 1976-80 level (see figure 9 and inset, Basis for Estimating 1990 Production). We expect the corn grain area in 1990 will be about 5 million hectares—an increase of about 2 million hectares over the 1976-80 level, but far short of the 14 million hectares suitable for corn grain. Average yields will probably be somewhat higher than historical trends, but still short of potential, given lags in applying

[3] Combines can serve as picker-shellers for harvesting corn once the combine is equipped with a row-crop header. [redacted] 25X1

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Basis for Estimating 1990 Production

Corn *and* sorghum *production estimates are a combination of yield and area projections. Estimates for corn and sorghum yields conform to a previous CIA study* [redacted] *which projects the likely total Soviet grain production in 1990 on the basis of an analysis of weather and technology trends. We projected about 2 million more hectares of cornland over the 1980 area of 3 million hectares because corn area was already expanded by about 1 million hectares during 1980-85. For sorghum we project an increase to about 200,000 hectares—from a very small base of about 150,000 hectares—on the basis of the expansion of sorghum area since 1980. The production estimates for the two crops for 1990 were then derived by multiplying the estimated yields—about 15 and 40 centners for sorghum and corn respectively—by their projected areas.* [redacted]

The estimate for soybean *production by 1990 was based on past record levels for area and yield. We assumed that the Soviets would achieve a yield of 10 centners—about the record yield of 9.6 centners achieved 10 years ago. And, assuming a small increase in area over the 1972 record year of about 900,000 hectares, we project that the cultivation of soybeans could reach 1 million hectares by 1990, resulting in 1 million tons of production.* [redacted]

advanced agrotechnologies. We estimate that, as a result, average corn yields on all lands—irrigated and nonirrigated—by 1990 will increase to 40 centners per hectare from the officially reported 32.7 centners in 1981-85. [redacted]

We estimate that production will substantially increase by 1990 for the other two feed crops as well. Although we believe the 1990 *soybean* goal of 2.2-2.3 million tons is far beyond what the Soviets will achieve, production may reach as much as 1 million tons because of slight increases in expanded plantings and yields. We expect output of grain *sorghum* to triple by 1990, but it will remain minimal as a share of all grain production. [redacted]

Overall Soviet grain production will rise somewhat less than the estimated increased production of corn and sorghum. Because these crops will replace lower yielding traditional crops, production of wheat will fall at the same time. Nonetheless, the higher yields of the new crops will generate a 5-million-ton net gain in total grain output by 1990. [redacted] 25X1

25X1

Long-Term Potential Gains Great 25X1

We believe the long-term potential for increasing Soviet production of corn and sorghum grains and soybeans far exceeds Soviet near-term goals and prospects for these crops. Even at existing levels of agrotechnology, expansion of *corn* and *sorghum* areas to levels projected by Soviet researchers on both irrigated and nonirrigated lands could increase overall grain output over present cropping patterns by roughly 17-19.5 million tons, as compared with the 5 million tons we expect the Soviets will actually gain by 1990 (see appendix C). This potential represents about 10 percent of our most likely estimate of grain production for 1990.[4] By the year 2000, the planned expansion of irrigated land would permit further increases in corn and sorghum areas, which could boost annual Soviet grain output by up to 30 million tons: 25X1 25X1

	1990	2000
		Million tons
Corn	16-18	20-25
Sorghum	1-1.5	4-5
Total	**17-19.5**	**24-30**

25X1

[4] [redacted] we concluded that the USSR will still need grain imports in 1990. This conclusion is based on estimates that there is a 95-percent probability that Soviet grain production during 1986-90 will average between 180 and 210 million tons, given weather conditions close to long-term averages (past 40 years) and application of fertilizers at levels slightly higher than during the last four to five years. The study also concludes that the Soviets have at least two options for boosting grain output substantially above this most likely estimate: grain yields could be raised significantly by importing more and better agrochemicals and improving application techniques; and overall production could be increased by changing the crop mix—especially the substitution of corn for wheat and other grains on irrigated lands. [redacted]

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If this additional grain were efficiently rationed to livestock herds, meat production could increase as much as 20 percent above the average level for the period 1976 to 1980. The potential gain by 2000 is equivalent to about 80 percent of average annual grain imports in recent years. [redacted]

In the case of added *soybean* output, increases possible in soybean production would improve the supply of protein in livestock feeds, although the displaced cereal grain would mean a loss of feed energy. For example, our analysis shows that increased production of soybeans close to plan would result in a net increase of roughly 1 million tons of protein content by 2000, while displacing corn from about 1.5 million hectares of existing cropland (see appendix C). This net increase in soybean output greatly exceeds average annual imports of soybeans and meal—some 0.3 million tons—from the United States during the period 1980-84 (see table 2). [redacted]

Implications

The program to shift the Soviet crop mix is clearly good news for Soviet agriculture and, ultimately, the Soviet consumer. It is designed to increase Soviet domestic production of the very crops the United States is best positioned to supply—the crops that have driven the growth in US exports to the Soviet Union over the last 10 to 15 years. The program, moreover, would help stabilize production during years of bad weather. [redacted]

The impact of the program over the next five years, however, will be modest in our view. The net increase of approximately 5 million tons of grain that we expect the Soviets to achieve is only 10 to 15 percent of the grain we estimate Moscow will need to import on average to meet its livestock production goals during the next five years—about 40 million tons annually.[5] The somewhat larger amount of concentrated feeds than would otherwise be available, however, will give a bit of a boost to livestock productivity. We estimate that by the end of this decade the net increase in corn, sorghum, and soybeans, if devoted to meat production, could provide an additional several hundred thousand tons, worth more than a half billion dollars at current prices if bought in the West. Requirements for US grain exports should be lessened a bit on average since corn represents a large portion of US exports to the Soviet Union. The general scale of US exports to the USSR of corn, sorghum, and soybeans will still be more dependent on such factors as weather fluctuations and bilateral relations. [redacted]

Over the longer term, our analysis suggests that the Soviets could substantially reduce their need for Western grain should they decide to take fuller advantage of this program to restructure the crop mix. The potential net gain of up to 30 million tons in total grain output compares favorably with our projected Soviet import requirements for grain during the next five years and is larger than the record US exports to the Soviet Union of 22.3 million tons during the marketing year 1984/85. With a potential this large, shifting the crop mix to increase production of corn and sorghum would work against a general expansion of US grain exports—the bulk of which is corn to the Soviet Union. [redacted]

If the Soviets decide to accelerate efforts to change the crop mix, we might expect over the next one to three years to see Moscow:

- Increase purchases of agrochemicals and hybrid seeds from the West to improve yields substantially.
- Begin to make more serious efforts to improve crop-breeding research to better tailor corn, sorghum, and soybean varieties to specific agroclimatic conditions (as has been done more successfully in developing and introducing high-yielding wheat varieties).
- Increase procurement prices of these three crops relative to traditional grains substantially more than they did two years ago in an effort to help overcome farm officials' resistance to increased plantings.

[redacted] the Soviets will probably need some 40 million tons of grain imports annually to meet 1990 meat production targets, assuming average weather and a continuation of recent trend in fertilizer deliveries. [redacted]

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Perhaps the strongest indicator of a serious shift in Moscow's agricultural management strategy would be the lifting of the prohibition on direct contact at the working level between foreign suppliers of agrotechnologies and Soviet farms. This has traditionally been the major limiting factor in the effectiveness of technology transfers to the Soviet system regardless of the economic endeavor. Any move in this direction in programs affecting grain production could pay big dividends during the 1990s. [redacted] 25X1

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Appendix A

Growing Corn, Sorghum, and Soybeans in the Soviet Union

Under Khrushchev's program, the Soviets increased plantings of *corn* substantially for both grain and forage.[6] From only 4.3 million hectares in 1954, corn plantings reached an alltime high of 37.1 million hectares in 1962, although only 7 million hectares were harvested for corn grain. Subsequently, the corn area declined, reflecting the discrediting of the Khrushchev program and a policy shift to wheat and other grains. The drought in 1963 and the new leadership's desire to distance itself from Khrushchev's policies discouraged these early efforts, and corn output failed to approach the levels of the early 1960s again until 20 years later. (See appendix B for historical statistics on various aspects of corn, sorghum, and soybean production in the USSR.) [redacted]

The Khrushchev corn program, while a victim of swings in political fortunes of the time, was successful in giving the Soviets an excellent source of forage they badly needed. Soviet farms previously had been greatly dependent on poor-quality wheat straw and pastures to supplement limited supplies of grain for livestock feed. Corn stalks are much more nutritious than wheat straw and chaff as livestock feed. [redacted]

Currently, four-fifths of Soviet corn area, including 1.2 million hectares of irrigated land, is planted exclusively for forage. Corn for grain is presently limited to the southern regions, where agroclimatic conditions are better suited; the European regions account for three-fourths of the output. The Soviets have steadily increased the amount grown on irrigated land, contributing to increased yields and reliability of production. In 1984 irrigated land provided about 40 percent of all Soviet corn grain, compared with 5 percent in the period 1966-70. [redacted]

[6] The corn is harvested as a chopped green mass; some is fed to livestock immediately, but most is stored as silage and fed later. Corn stalks or stover, from which mature ears have been removed, are more nutritious than small grain straw and also are commonly fed to certain livestock like cattle and sheep. [redacted]

A 1959 Soviet study by P. M. Zemskiy[7] assessing the potential to grow more corn concluded that 33 million hectares of corn could be planted in the USSR, of which 14 million could be harvested for fully mature grain. The Soviets exceeded the projection for total area planted to corn by a considerable margin in 1962 and 1963—37.1 and 34.2 million hectares respectively—but they have always failed to achieve the projection for corn grain. [redacted] 25X1

The area under *sorghum* cultivation has always been small and is usually the least favorable land, according to Soviet press reports. Sorghum for both grain and silage is generally limited to corn grain regions. The distribution of sudan grass and other forage sorghum is much wider and similar to corn for forage. 25X1 In 1956 the Soviets grew 1.9 million hectares of all sorghum, but only 73,500 hectares for grain. Currently, the total area is only half as large, but the area for grain has doubled. [redacted] 25X1

In our view, the potential USSR sorghum area is much larger because of its unique adaptation to certain unfavorable moisture, soil, and temperature conditions. 25X1 The crop is particularly resistant to drought. Zemskiy projected a potential grain sorghum area of only 178,200 hectares, of which 83 percent would be in Central Asia and Kazakhstan. But in 1973 the Vavilov All-Union Scientific-Research Institute for Crop Raising projected an eventual sorghum area of 4-5 million hectares, terming this a large reserve for grain and forage output in semiarid and arid regions. In 1985, Soviet scientists claimed it is possible for grain sorghum cultivation to reach 1 million hectares in "the near years" and 3 million 25X1 hectares "over the longer term." [redacted] 25X1

[7] *Rasvitiye razmeshcheniye zemledeliya po pirodno-khozyazstvennym rayonam SSSR*, Moscow: USSR Academy of Sciences, 1959. [redacted] 25X1

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Since 1960 the area planted to *soybeans* has remained relatively stable, averaging about 830,000 hectares per year, although it declined in 1984 to 772,000—considerably below the planned 890,000 hectares. As of 1982, 84 percent of the soybean area was in the Russian Federation (RSFSR), of which 80 percent was in the Far East region. 25X1

According to Soviet press reports, soybeans are now planted on 30 to 35 percent of all sown area in the Soviet Far East, which in the Soviet view exceeds the optimum share. Hence, the Soviets plan to expand soybean area on irrigated lands in Central Asia, southern Kazakhstan, the Transcaucasus, Moldavia, North Caucasus, and the Ukraine steppe, and to introduce soybeans to the lower Volga and Central Chernozem regions. During the period 1976-81, the total soybean area increased 13 percent, with no increase in the total RSFSR area but more than a tenfold increase in the Ukraine and North Caucasus areas, nearly a fourfold increase in Kazakhstan, and more than a twofold increase in Moldavia. The Far East area apparently declined about 5 percent. Soviet projections for 1990 call for roughly doubling soybean area to about 1.7 million hectares. 25X1

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Appendix B

USSR: Historical Statistics Showing Area, Yields, and Production of Corn, Sorghum, and Soybeans in 1913, 1940, and 1950-85

Table 4
USSR: Corn Area, Yields, and Production

	All Corn	Corn for Grain [a]			Corn for Forage		
	Area *(thousand hectares)*	Area *(thousand hectares)*	Yield per Hectare *(centners)*	Production *(thousand tons)*	Area *(thousand hectares)*	Yield per Hectare *(centners)*	Production *(thousand tons)*
1913	2,176	2,176	9.4	2,051			
1940	3,690	3,690	13.9	5,120			
1950	4,829	4,829	13.8	6,644			
1951	4,061	4,060	NA	NA			
1952	3,887	3,887	NA	NA			
1953	3,485	3,485	10.6	3,697			
1954	4,252	4,252	8.7	3,699			
1955	17,917	6,176	18.7	11,574	11,741	49	58,117
1956	23,931	6,604	14.9	9,861	17,327	60	104,060
1957	18,272	3,256	14.2	4,621	15,016	67	101,297
1958	19,725	4,402	23.2	10,226	15,323	134	209,772
1959	22,414	3,547	15.9	5,653	18,867	125	236,749
1960	28,165	5,086	19.3	9,823	23,079	132	314,657
1961	25,645	7,145	24.0	17,113	18,500	122	231,741
1962	37,105	7,005	22.1	15,474	30,100	80	242,963
1963	34,195	6,995	15.9	11,143	27,200	70	190,503
1964	27,414	5,114	27.1	13,849	22,300	124	279,075
1965	23,404	3,177	25.3	8,030	20,227	88	181,157
1966	23,109	3,229	26.1	8,416	19,880	108	217,268
1967	23,045	3,485	26.3	9,163	19,560	114	225,012
1968	22,351	3,350	26.4	8,828	19,001	104	200,531
1969	22,629	4,167	28.7	11,954	18,462	121	226,271
1970	21,363	3,353	28.1	9,428	18,010	117	212,046
1971	21,167	3,332	25.8	8,597	17,835	117	210,862
1972	21,908	4,012	24.5	9,830	17,896	112	206,136
1973	20,958	4,031	32.8	13,216	16,927	163	281,744
1974	21,082	3,955	30.6	12,104	17,127	129	226,464

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Table 4
USSR: Corn Area, Yields, and Production (continued)

	All Corn	Corn for Grain [a]			Corn for Forage		
	Area *(thousand hectares)*	Area *(thousand hectares)*	Yield per Hectare *(centners)*	Production *(thousand tons)*	Area *(thousand hectares)*	Yield per Hectare *(centners)*	Production *(thousand tons)*
1975	19,998	2,652	27.6	7,328	17,346	108	192,981
1976	21,417	3,303	30.7	10,140	18,114	149	277,136
1977	18,919	3,362	32.7	10,995	15,557	155	246,803
1978	19,230	2,535	35.1	8,900	16,695	147	250,656
1979	19,465	2,667	31.2	8,320	16,798	133	229,852
1980	19,935	2,977	31.7	9,437	16,958	154	266,168
1981	19,769	3,545	30.4	10,785	16,224	139	232,085
1982	21,002	4,161	35.1	14,600	16,841	169	293,613
1983	21,476	3,984	32.7 [e]	12,750 [e]	17,492	163	297,884
1984	21,763	3,919	34.0 [f]	13,320 [f]	17,844	162	296,000
1985	21,893	4,482	35.7 [f]	16,000 [f,g]	17,411	165 [f]	295,000 [f]

Source: Official Soviet Statistics, except as noted.

[a] Fully mature grain.
[b] For green mass fed immediately or stored as ensilage.
[c] Harvested exclusively for forage.
[d] Including forage from areas also harvested for corn grain and double-cropped.
[e] Output reportedly a third above 1976-80 annual average.
[f] Estimated.
[g] According to a Soviet deputy minister, "output in 1985 reached 16-18 million tons."

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Table 5
USSR: Sorghum Grain Area, Yields, and Production

	Area *(thousand hectares)*	Yield per Hectare *(centners)*	Production *(thousand tons)*		Area *(thousand hectares)*	Yield per Hectare *(centners)*	Production *(thousand tons)*
1913	NA	NA	NA	1967	42.0	11.9	50.0
1940	NA	NA	NA	1968	46.0	12.6	58.0
1950	54.9 [a]	NA	NA	1969	56.0	13.4	75.0
1951	68.2	NA	NA	1970	39.0	13.9	54.0
1952	61.2	NA	NA	1971	35.0	16.0	56.0
1953	54.0	NA	NA	1972	45.0	11.1	50.0
1954	50.4	NA	NA	1973	90.0	10.9	98.0
1955	57.0	NA	NA	1974	132.0	16.6	219.0
1956	73.5	NA	NA	1975	77.0	13.8	106.0
1957	NA	NA	NA	1976	196.0	8.0	157.0
1958	NA	NA	NA	1977	90.0	15.2	137.0
1959	NA	NA	NA	1978	88.0	10.9	96.0
1960	NA	NA	NA	1979	80.0	11.1	89.0
1961	70.0 [a]	8.6 [a]	60.0 [a]	1980	98.0	12.1	119.0
1962	90.0 [a]	6.7 [a]	60.0 [a]	1981	92.0	10.9 [a]	100.0 [a]
1963	70.0 [a]	9.3 [a]	65.0 [a]	1982	132.0	7.6 [a]	100.0 [a]
1964	99.0 [a]	8.7 [a]	86.0 [a]	1983	151.0	12.6 [a]	190.0 [a]
1965	64.0	9.5	61.0	1984	143.0	14.0 [a]	200.0 [a]
1966	47.0	12.3	58.0	1985	187.0	13.4 [b]	250.0 [b]

Source: Official Soviet statistics, except as noted.

[a] Data reported in UN/FAO Production Yearbooks. Also reported were average annual data for 1948-52 as follows: area, 63.0; yield, 8.9; and production, 56.0. Production and yield data for 1981-84 are FAO estimates.
[b] Estimated.

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Table 6
USSR: Soybean Area, Yields, and Production

	Area *(thousand hectares)*	Yield per Hectare *(centners)*	Production *(thousand tons)*		Area *(thousand hectares)*	Yield per Hectare *(centners)*	Production *(thousand tons)*
1913				1967	850.0	6.4	543.0
1940	289.0	8.1	233.2	1968	854.0	6.2	528.0
1950	383.3	4.3	166.0	1969	851.0	5.1	434.0
1951	335.7	4.3	145.0	1970	860.0	7.0	603.0
1952	327.9	4.3	142.0	1971	868.0	6.2	535.0
1953	299.5	5.7	172.0	1972	905.0	2.9	258.0
1954	299.1	1.9	56.0	1973	838.0	5.1	424.0
1955	269.7	5.6	151.0	1974	822.0	4.4	360.0
1956	318.9	3.6	114.0	1975	811.0	9.6	780.0
1957	389.0	4.2	162.0	1976	762.0	6.3	480.0
1958	387.0	5.9	229.0	1977	786.0	6.9	540.0
1959	455.0	4.9	224.0	1978	815.0	7.8	634.0
1960	423.9	3.9	167.5	1979	838.0	5.6	467.0
1961	702.0	4.9	344.0	1980	854.0	6.1	525.0
1962	825.0	5.8	475.0	1981	864.0	5.2	450.0
1963	885.0	5.1	450.0	1982	876.0	5.5	480.0
1964	886.0	3.3	293.0	1983	842.0	6.6	560.0
1965	852.8	4.9	420.6	1984	772.0	6.5	500.0
1966	854.0	6.9	586.0	1985	738.0	6.8 [a]	500.0 [a]

Source: Official Soviet statistics, except as noted.

[a] Estimated.

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Appendix C

General Methodology for Estimating Potential Gains

Our assessment of the potential for a restructured crop mix to increase feed grain production in the USSR starts with the selection of geographic regions agronomically suitable for these crops. With the potential increases in areas defined, our methodology then accounts for increases in yields that could be achieved, taking into account the traditional crops displaced and the degree to which irrigation would be used. Our calculations of potential gains assume that agrotechnology improvements continue the existing trend,[8] given the numerous problems and lags the Soviets experience in getting new technologies implemented at the farm level. [redacted]

Furthermore, the calculations are based on a total cultivated area that is similar in size to that of today. For the Soviets to add substantial amounts of new arable land suitable for these crops by 2000, they would have to complete much of the planned work to bring water from Siberian rivers into Central Asia. While the Soviets eliminated reference to these river reversal programs in their official statement of the plan at the 27th Soviet Communist Party Congress held in March 1986, they did not alter their earlier proposals to increase irrigated land area for 1990 and 2000. Our estimate of potential gains, therefore, reflects only increases in irrigated land coming from existing nonirrigated arable land. Most of these gains in irrigation by 2000 will be in the European part of the USSR, where construction has begun on river diversion projects to increase the supply of irrigation water. [redacted]

Corn and Sorghum
We calculated that larger plantings of sorghum and corn grains could result in net increases in grain production of roughly 17-19.5 million tons by 1990 and 24-30 million tons by 2000. Corn grain expansion would represent more than 80 percent of this potential. However, we expect the Soviets to actually achieve substantially less by 1990. Our projected net gain of only about 5 million tons by 1990 reflects a considerably smaller area—only about 5 million hectares—devoted to corn and sorghum grains than potentially warranted:

- To estimate the potential by 1990, we postulated that corn and sorghum grain *areas* together could occupy about 14 million hectares—Zemskiy's projection—as compared with 3 million hectares harvested on average during 1976-80 and 4 million hectares during 1981-85. About half of this expansion was allocated to irrigated areas, as Soviet farm officials currently prefer to grow other crops, especially winter wheat, on irrigated land. From 1990 to 2000, we assume an additional increase of 2 million hectares in total area of corn and sorghum grain. Half of this would be on additional arable land the Soviets plan to bring under irrigation in the southern USSR.

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- We expect that, by 1990 and 2000, the difference in corn *yields* over other grains will have widened a bit because of moderate improvements of agrotechnology. We expect that on irrigated land corn will outyield winter wheat—the most competitive of the small grains—by as much as 25 to 28 centners per hectare by 1990 and 28 to 34 centners per hectare by 2000. On nonirrigated land the differences would be considerably smaller—about 8 to 9 centners per hectare in 1990 and 9 to 11 centners in 2000. For grain sorghum, we expect the gains in yields will be roughly 20 percent of the incremental gain in corn yield, as the Soviets have placed greater emphasis on corn cultivation in the past.

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[8] Agrotechnology improvements are reflected in changes over time of the yields of various crops. For example, increased application of fertilizers and other agrochemicals is reflected in this trend. [redacted]

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- Net increases in grain *production* are derived by simply multiplying net increases in area times net increases in yields. This gives potential net gains of roughly 17.0-19.5 million tons in 1990 and 24-30 million tons in 2000.

Soybeans

We used a somewhat different procedure to illustrate the potential impact of increasing soybean production on total Soviet livestock feed supplies. Our calculations assess the impact on both feed energy and protein available in the event that Soviet future plans for area, yield, and production of soybeans are fulfilled. This approach was necessary since soybeans—like other leguminous kernel crops—do not compete directly with grain crops because, as a rule, they yield less tonnage and less feed energy but more and better feed protein than the cereal crops they displace. For this reason, we calculated the trade-off in increased production of feed protein from a larger area of soybeans and reduced production of feed energy by hypothetically displacing corn—the most competitive of cereal grains because of its high yield potential. The balances relative to feed energy and protein content are, therefore, based on the difference in corn production losses and production gains from increased plantings of soybeans:

- To reach the planned *areas* of 1.7 million hectares by 1990 and 2.0-2.5 million hectares by 2000, the Soviets will have to at least double the amount of land planted to soybeans in 1980—0.85 million hectares. We obtained net increases in area by subtracting the 1980 area from the areas planned for 1990 and 2000.

- In calculating net potential increases in soybean *production,* we assumed *yields* will increase from about 6 centners in 1980 to the planned goals of 12.9-13.5 and 20 centners by 1990 and 2000, respectively. The product of the net increase in the area and the net increase in yield results in potential increase in soybean production of 1.7-1.8 million tons by 1990 and 3.5-4.5 million tons by 2000.

- We assumed that the additional soybean production would be at the loss of corn output because corn and soybeans compete for land in similar agroclimatic regions. The loss in production of corn was derived by multiplying losses of corn grain area—0.85 and 1.5 million hectares—and expected corn yields for 1990 and 2000. This calculation resulted in an estimated loss of 3.4-3.6 million tons in 1990 and 4.9-6.8 million tons in 2000. 25X1

- The *feed energy* and *protein content* balances from soybeans displacing corn show losses in terms of feed energy. However, there would be a significant increase over time in the protein content of livestock feed, which is in short supply in the USSR. Digestible nutrients—a standard measure of feed energy—would be down by 1.6-1.7 million tons in 1990 and 1.6-2.5 million tons in 2000, but digestible protein content would be up by 0.3-0.4 million ton in 1990 and 0.9-1.1 million tons in 2000. 25X1

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